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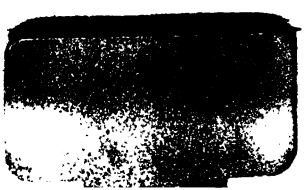

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WHO WERE THE FIRST WEAVERS?

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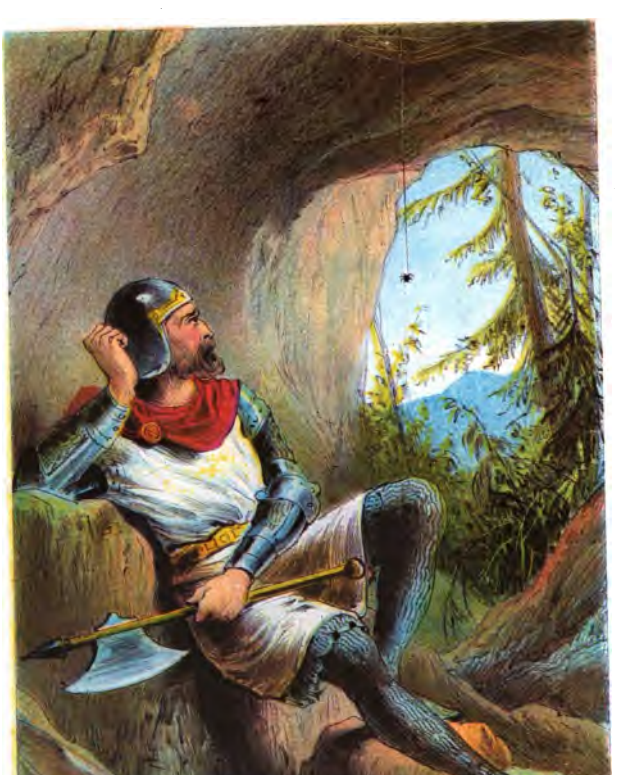

BRUCE AND THE SPIDER

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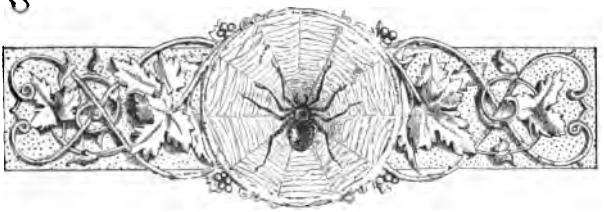

WHO WERE

THE FIRST WEAVERS?

"Each moss,
Each shell, each crawling insect, holds a rank
Important in the plan of HIM who framed
This scale of beings."

LONDON:
T. NELSON AND SONS, PATERNOSTER ROW;
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1874.

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WHO WERE THE FIRST WEAVERS?

CHAPTER I.

THE SPIDER AND ITS WEB.

"They spread their nets, whether they be
In poet's tower, cellar, barn, or tree."

WHEN the youthful reader takes up this little volume, he will probably be tempted, at first, to look upon it as some dull, dry, uninteresting, but very learned and perhaps valuable treatise on *Weaving;* and on the claims of different persons to be considered the inventors of certain wonderful looms, spinning-jennys, and other ingenious

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methods for converting the tissue of plants into cotton and linen, or the wool of sheep and goats into sound broadcloth.

But of no such matters am I going to discourse to-day. Long before man discovered the uses of wool or flax or cotton, there were little weavers at work among the woods and groves of the young world,—industrious little weavers, which, without the aid of machinery other than was afforded by their own bodies, spun a woof of such exquisite fineness that our most ingenious mechanism has never been able to surpass, nay, to equal it; and of such remarkable strength, that a single thread will bear the pressure of thirty times its own weight!

These weavers were the first in the field, and they are still at work!—or rather, I should say, their descendants are now at work; and you cannot go forth into your garden on a bright spring morning without seeing the most superb specimens of their manufacture hung from bough to bough, or

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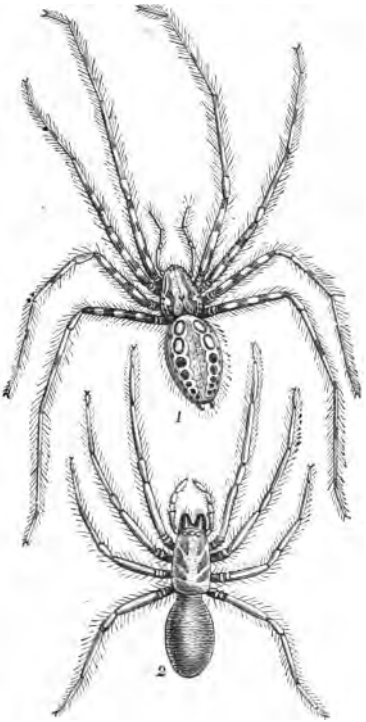
spread along the leafy hedge, as if to challenge your admiration.

The weavers I speak of are, as you will have guessed, the SPIDERS!

There are silly people in the world who profess to be frightened at these curious and interesting insects;* who scream and shriek when one of them crosses their path, or makes its appearance on the shining wall. The most absurd superstitions were at one time



1. HOUSE SPIDER. 2. CAVE SPIDER.

* They are popularly called insects, although they have eight legs instead of six, and breathe through gills situated under the belly.

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entertained concerning them. Would you believe that it was thought unlucky to kill a spider? Now, I need hardly tell you that no such thing as luck, or chance, or want of luck, exists in this world. All that occurs is the result of certain unchangeable laws, which have been decreed by the Divine Governor of the universe. So far as we follow up and obey these laws, so far may we expect to enjoy peace of mind and a contented conscience: if we break them, the result must always be unhappiness, and trouble, and sore affliction. To kill a spider, then, is, or under most circumstances will be, cruel—just as it is cruel to ill-treat *any* animal or form of life whatsoever; but there is no other reason why it should be unlucky.

And there is no reason why the little spiders often met with in fields and woods, and vulgarly called *money-spiders* or *money-spinners*, should be considered omens of good fortune, if not destroyed or injured, or removed from your person when first observed.

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You are not so silly as to think that the events and changes of life can in any way depend on the appearance of a tiny spider!

In the diary of an eccentric but clever individual, Elias Ashmole, the founder of the Ashmolean Museum at Oxford, may be found the following passage: "I took early in the morning a good dose of elixir, and hung three spiders about my neck, and they drove my ague away." Perhaps the elixir —whatever that may have been—*had* a good effect; but no boy or girl who reads these pages will fancy that "three spiders" suspended to a person's neck could be of any genuine benefit to him.

Still, I am prepared to confess that the spider is really a wonderful creature. Who that admires the beautiful gossamer threads embroidering leafy hedge and flowering bush like fairy net-work, would imagine they were woven by one apparently so insignificant, and even contemptible? But if you ask, How does it weave them? Whence does it obtain

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the exquisitely fine and yet strong threads of which they are composed? How does it carry them from point to point? How does it contrive to fasten them to distant objects? And, before all and above all, what *is* a spider? These are the questions I am now about to answer, in language as plain as I can make it.

The apparent flight of the wingless spider from tree to tree, says an agreeable writer, across water, and even through the upper regions of the air, was long almost as great a puzzle to naturalists as the fly's walking with its head and body reversed. No doubt it was soon discovered that this apparent flight was nó more a real one than that of an aeronaut in a balloon; or than the bounds and leaps of adventurers who, like Blondin, have disported themselves above men's heads on a suspended rope.

Any one could see, if he made use of his eyes—which is the last thing, however, that most persons learn to do—that the spider

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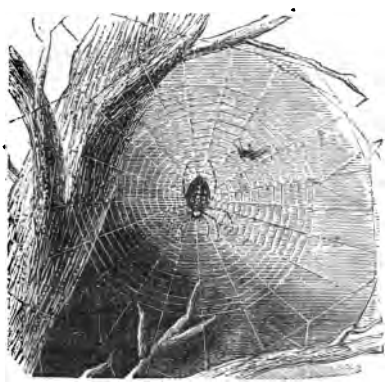
moved along a *line*, in somewhat the same fashion as a rope-dancer. But then the marvel is, that while in Blondin's case the rope is stretched between two stout supports before he begins his aërial journey, the spider lays down *his* line by *his* own will and effort as he proceeds upwards or downwards, from tree to tree, or from the ceiling of a room descends to its floor.



A GOSSAMER WEB.

It has been well observed, that, however ignorant one may be of their mode of formation, one cannot fail to notice—and, noticing, to admire—those gossamer webs of which we have spoken. Their amazing extent—for they frequently cover an entire hedge or garden walk—is not more surprising than the

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immense number of their *weavers*, of whom twenty or thirty will sometimes be found assembled on a solitary straw. It would appear, on these occasions, as if something of the lark's soaring spirit, infused by his cheerful song, animated each little creeping form. All seem desirous to mount upwards—to rise towards the Source of life and light; all are in progress towards the summit of their various stations, whether blade of grass or twig of hedge. And when once they have climbed to the greatest height their legs will carry them, they elevate their abdomens to a nearly perpendicular position, and at the same time emit, or eject, a portion of the glutinous substance which forms their webs. This being acted on by the ascending current of air, is quickly drawn out into long fine lines,—just like a fringe of silk when blown by the breath,—which serve the little spiders as balloons or supports to bear them upwards into the sunlit air.

After awhile, the air still acting upon

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them, these long thin lines are brought into the shape of fleecy flakes, something like crystals of snow: and who has not amused himself with puffing these tiny balloons, and blowing them to and fro, like a shuttlecock set in motion by a battledore?

It is said that showers of gossamers have occasionally fallen—showers of little spiders and their webs! Gilbert White describes a shower which fell at Selbourne in the autumn of 1741, and extended over an area of thirty miles. The webs, he says, were not single filmy threads, floating in the air in all directions, but perfect flakes or rags, some near an inch broad, and five or six long; and they fell with a swiftness which showed that they were considerably heavier than the atmosphere. On every side, as the observer turned his eyes, he beheld a continual succession of fresh flakes falling into his sight, and twinkling like stars as they turned their sides towards the sun.

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In fact, the gossamer threads woven by our skilful little weavers are so delicate that they can only be seen when the sun shines upon them, or when the wind has beaten them together into thicker flakes. Sometimes you will feel them on your face when you are positively unable to detect them by your eyesight. *Why* the spider weaves them has not been satisfactorily settled. From the great eagerness for water to drink which he exhibits, some naturalists have thought that they may be formed for the purpose of collecting dewdrops. Others have conjectured that they are intended to convey their manufacturers with greater rapidity from place to place. And others, again, believe that they are traps for the capture of the insects on which, as they suppose, the spiders live.

At all events, we know that they are the work of tiny creatures no bigger than a pin's head; each with a shining dark-brown body, eight yellowish legs, eight eyes—placed in a

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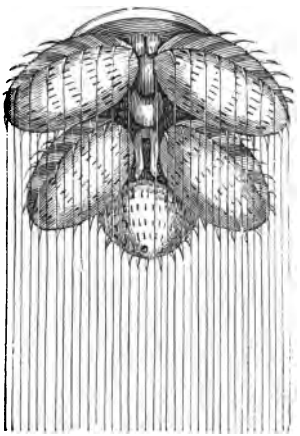
circular form on the fore-part of the head—and a wonderfully constructed spinning apparatus. In the lower part of the abdomen is situated a bag or reservoir, containing a thick glue-like fluid; and this bag, or reservoir, is furnished with five teats, or *spinnerets*, as they are called, each having a vast number of small hair-like tubes, termed *spinnerules*—as many, perhaps, as a thousand spinnerules to each spinneret: and through these spinnerules the spider has the power of ejecting its liquid; which, on exposure to the atmosphere, becomes solid, and forms what we speak of as his *web*. The whole of the threads issuing from the five or six thousand spinnerules are twisted, like the strands of a cable, into a single line, forming an example



SPINNERETS.

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of skilful weaving such as can hardly be equalled in the whole world.

And so, on a sweet calm summer evening,—

> "When gentle winds, and waters near,
> Make music to the lonely ear,"

and the sky is glorious with emerald, and purple, and orange,—with azure, and crimson, and gold,—the splendours of the sun, as he sinks like a monarch to his rest,—

> "On the shining air
> That tiny aeronaut, the gossamer,
> Launches its web, and journeys merrily."

Then, in every direction, its veil of silvery tissue decks twig, and bough, and branch with an exquisite tapestry, and gleams and sparkles over hedgerow and leafy copse;—on the tendrils of the lush woodbine, and the deep green masses of the clustering ivy; on the hoary trunk of the shattered tree, and the gray old buttress of the ancient wall. It enriches with its delicate tracery the freckled cups of the haughty foxglove; winds like

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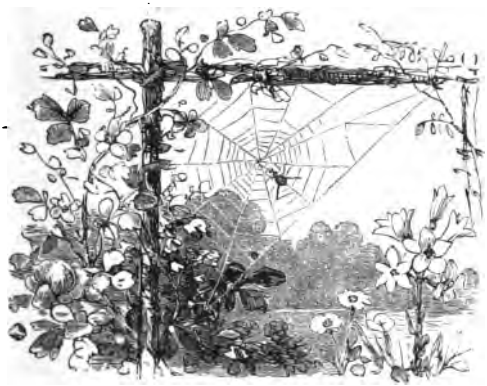
a garland round the bending head of the modest blue-bell; contrasts its sparkling diamond threads with the rich scarlet berries of the dogwood; and fringes the tender clematis with a surpassingly beautiful decoration. And ever and anon, as some passing



WEB OF THE GARDEN SPIDER.

upward breath of air wafts the light web towards the clouds, we see the aërial voyager floating hither and thither, like a young man's fancy, until it is carried far beyond our wistful ken.

Now we must proceed to speak of the

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spider scientifically, and with some degree of method in our observations.

He belongs to a family called *Arachnidæ*, and though popularly spoken of as an insect, differs greatly in his structure from the insect proper. His body consists of two portions only, the head being united with the thorax;* and the feet are always eight in number. The head and chest appear to be composed of only a single segment, and are covered with a kind of horny armour, like an oval shield, to which the soft and swelling abdomen is attached.

Most spiders have eight eyes, though a few species have but six; and these are differently disposed in different genera.

The mandibles—that is, the upper and lower jaws—terminate in a very short movable hook, like a claw; near whose extremity is placed a small orifice, or opening, which affords a passage for the venom.

The legs are attached to the anterior part

* This is the fore-part of the body.

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of the body, almost in a ring. They are nearly all of the same form; and each consists of seven joints, the last of which is armed with two hooks.

Being designed by an Almighty Providence to secure his food by his own ingenuity, all the habits of the spider are of an insidious and artful character. He catches his prey in skilfully devised snares, and lurks in the most ingenious concealments in order to pounce with "fell swoop" on his unsuspecting victim. He is endowed with force, patience, and skill; with skill to contrive his ambuscades — with patience to await the approach of his prey—with force to kill it when entangled in his toils.

We have already alluded to the mode in which he weaves his web, but the process is so marvellous as to justify us in entering upon a fuller explanation.

His reservoirs of fluid are four in number, two larger and two smaller: from these, which are placed near the extremity of the

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abdomen, projects a tube, terminating in the outer *spinnerets*. These, in the larger spiders, may be seen with the naked eye, and resemble five little teats, surrounded by a circle.

Now, take a strong magnifying-glass, and examine one of these said teats. What do we see? Numerous regular rows of minute points, like bristles, which are called, as I have previously told you, *spinnerules*, and emit a thread of surpassing fineness. A thread of surpassing fineness! and yet, in reality, made up of at least a hundred finer threads!

Leeuwenhoek—a great naturalist, who possessed an extraordinary faculty of observation—calculates that of these threadlets, as emitted by a young spider no bigger than a grain of sand, four millions would be required to equal in thickness a single hair of a man's beard!

So much for the *material* employed by our dexterous weaver in weaving his woof.

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The next point to be considered is, how is it carried across from one place to another?

Kirby tells us that, to gain information on this curious question, he took a large garden spider (*Epeira diadema*) and set him upon an upright stick in a vessel of water. Immediately he let himself drop; not by a single thread, but by *two;* each distant from the other about the twelfth of an inch, and one smaller than the other, and the two threads carefully guided by the spider's foot. When he had nearly reached the surface of the water, he stopped short, and by some means broke off, close to the spinnerules, the smaller thread, which still adhering by the other end to the top of the stick, floated in the air, and was so light as

THE GARDEN SPIDER.

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to be carried about by the slightest breath. On approaching a pencil to the loose end of this line, it did not adhere from mere contact. Mr. Kirby therefore twisted it once or twice round the pencil, and drew it tight. The spider, which had previously climbed to the top of the stick, immediately pulled at it with one of his feet, and finding it what the sailors call *taut* enough, crept along it, strengthening it as he proceeded by another thread, until he reached the pencil.

When a common or house spider is about to weave a web, he first looks out some secure and convenient place, where insects will probably be found in sufficient abundance. He then emits or secretes just one drop of his glutinous liquid—which sticks with all the tenacity of the best glue or gum — and, creeping up a wall, or along a beam, joining his thread as he moves forward, he darts with surprising agility to the opposite point, where he means to fasten the other end of his web.

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The first thread thus spun, fastened, and drawn tight, forms a kind of flooring, on which the spider runs to and fro, doubling and strengthening it, until it is perfectly secure, and fit for the foundation of his edifice.

Our little architect then proceeds to lay down a number of threads parallel to this primary and principal one, which he afterwards crosses with others, the edges being carefully secured that the wind may not blow the delicate structure into ruin. This done, the spider proceeds to form his den or retreat, which is shaped like a funnel, and provided with two outlets, one above and one below, so as to allow the inhabitant an opportunity of making excursions at suitable seasons, of examining every "nook and corner," strengthening any frail or injured portion, and cleaning those parts which become foul or encumbered. It may sometimes be seen that from the main web several smaller webs are extended at some distance

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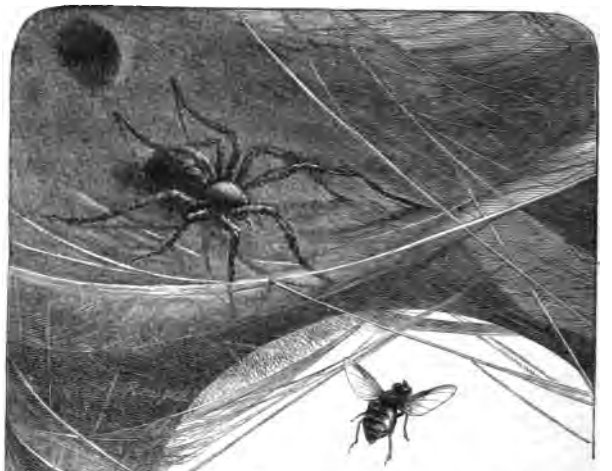

HOUSE SPIDER AND WEB.

on either side. These are the outworks of the fortress; and the moment they are touched from without, the garrison prepares for attack or defence. Should the assailant prove to be a fly, it finds itself speedily in a helpless position; should it be some enemy stronger than the spider, the latter retires

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within his remotest asylum until all danger is past.

But one spider differs from another spider, as one star differs from another star. There is no monotony in nature. The great Creator needed not to repeat Himself, and the varieties of His work are as inexhaustible as they are wonderful. The garden spider, for instance, does not construct his web exactly in the same manner as the house spider. He spins a considerable quantity of thread, which, floating in the air in various directions, fixes, after awhile, against some neighbouring object,—a plant, the branch of a tree, or a wall. As soon as one end of the line adheres, the little weaver begins to tighten and secure the other. Then, along the cord thus fastened, he walks to a certain point, where he attaches a second thread; and dropping from thence, fixes it to some solid object underneath. Immediately he is up again, and begins a third, which he fastens in a similar manner. The three threads thus fixed form a figure some-

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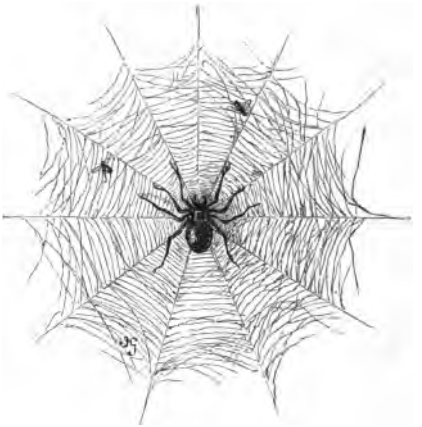
what resembling a square, in which the ingenious weaver is generally found located. It frequently happens, however, that when the young spider begins his work his web is made too light, and then away into the air fly both web and weaver!



THE SPIDER'S TRAP.

When an insect becomes entangled in the web, its struggles cause the threads to shake and quiver, and thus the spider receives, as if by telegraph, information of the presence of a victim. Forth he sallies, and if the

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prey be small, pounces upon it immediately, and sucks its blood. But if it be large, the spider rolls it with his hinder feet, and at every roll winds a new thread round it, until it is coated and swathed like a mummy, and in this helpless condition may be devoured at pleasure.

The webs are of different shapes, according to the species which weave them. Thus: some construct an irregular web, of threads crossing each other at right angles; others bind together a few leaves; * others seem to work on a perfect geometrical pattern. Not a few are aquatic, and their web resembles a cup in shape, and in principle a diving-bell; under which they disengage the air they bring down from the surface. Some spiders spin no web at all, but catch their prey by

* Another spider, common in woods and copses, says Rennie, weaves together a great number of leaves to form a dwelling for itself, and in front of it spreads its toils for entrapping the unwary insects which stray thither. These, as soon as caught, are dragged into the den, and stored up for a time of scarcity. Here also its eggs are deposited and hatched in safety. On the approach of winter, when the leaves wither, it retires to the shelter of a hollow tree; where, however, it soon dies.

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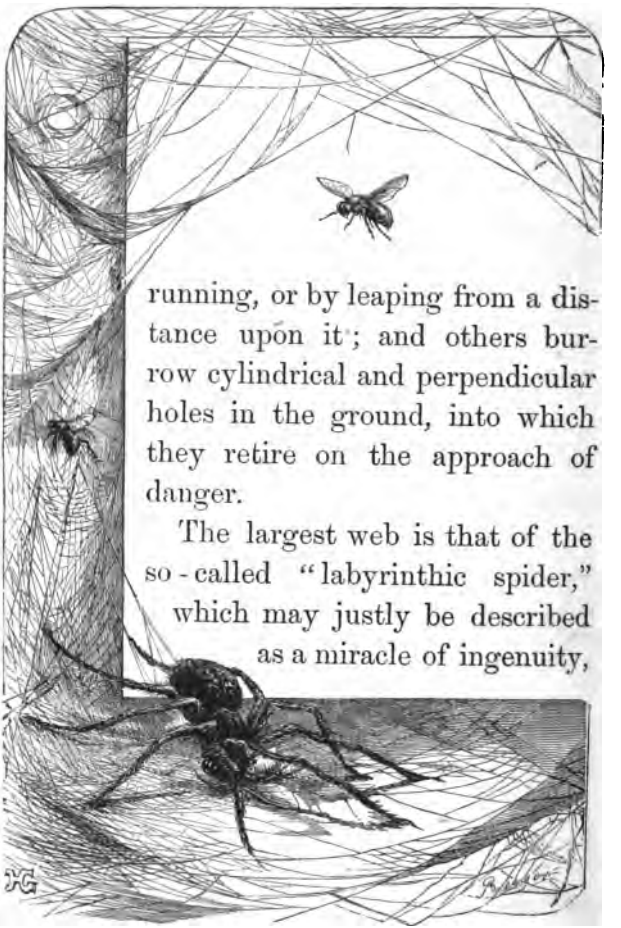

running, or by leaping from a distance upon it; and others burrow cylindrical and perpendicular holes in the ground, into which they retire on the approach of danger.

The largest web is that of the so-called "labyrinthic spider," which may justly be described as a miracle of ingenuity,

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—a masterpiece of constructive skill. It may be seen in the country, extended like a sail or sheet, in hedges, furze, and other low bushes, and sometimes on the ground.

The middle of this sheet is closely woven, and swung, like a sailor's hammock, by silken ropes stretched all around to the higher branches; but the whole curves upwards and backwards, and slopes down to a long funnel-shaped gallery, which at the entrance is almost horizontal, but soon winds obliquely until it becomes quite perpendicular.

This curved gallery is about one-fourth of an inch in diameter, is woven still more finely than the sheet part of the web, and occasionally descends into a cavity in the ground, though more frequently into a nest of entangled and matted twigs, or into a thick tuft of grass. Here the spider reigns, "monarch of all he surveys," frequently reposing with his legs extended from the entrance of the gallery, ready to pounce

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upon any unfortunate insect that may fall into his cunning snare, which he kills by ejecting into its body a deadly poison.

We have thus seen that though our weavers are very ingenious, they are also subtle, treacherous, and cruel. Their vices we may learn to avoid; but let us do them justice, and remember they are endowed with many virtues, which it will profit us to cultivate. "When a spider is found upon our clothes," says quaint old Fuller, "we used to say 'Some money is coming toward us.' The moral is this:—Such who imitate the industry of that contemptible creature, 'which taketh hold with her hands, and is in kings' palaces,' may, by God's blessing, weave themselves into wealth, and procure a plentiful estate."

But there are many things in this world better than wealth or a plentiful estate: namely,—

"Self-reverence, self-knowledge, self-control;"—

purity of heart and mind, charity, benevol-

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ence, truth, faithfulness, and honour. It is these virtues which make the Christian gentleman; and in our acquisition of them we may be greatly helped if we endeavour to attain the spider's two special and pre-eminent qualities—*patience* and *perseverance.*

By their patience and perseverance, says Augustine, the children of God are known from hypocrites and dissemblers.

Shakespeare exclaims,—

> "How poor are they who have not patience!
> What wound did ever heal but by degrees?"

And it is certain that the impatient man can never become *good* or *great;* can never accomplish any object, however desirable; can never grow into a profitable citizen or a true friend. It is equally certain that only by perseverance can we advantageously discharge our mission in this life, whether that mission be high or low, easy or difficult. "He that shall endure unto the end, the same shall be saved."

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There are many anecdotes told of spiders, which are interesting in themselves and valuable for the lessons they convey. Who has not heard of Pelisson, the unfortunate prisoner of the French Bastille, who, in the dreary solitude of his cell, found a companion in a little spider, training it by the music of his flute, until it came and went at his bidding? Who has not heard of that other Frenchman, Quatremère Disjonval, who likewise found in some spiders the pleasant solace of a dull captivity, and patiently beguiled the hours by watching their movements, and studying how far they were affected by approaching changes of the weather?

And, above all, who does not recollect the famous, but doubtful, story of Robert Bruce and the spider? It has been often told, but my young readers will forgive me if I tell it once again, and partly in Dr. Landsborough's graphic words:—

The tradition still lingers in Arran,—a

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beautiful island off the west coast of Scotland,—that King's-cross-point was so named, because from this point in Arran King Robert the Bruce sailed for Carrick, his own district in Ayrshire. When, by a train of adverse circumstances, driven almost to despair, it is said that after a sleepless night in a hut on this rocky headland, he in the morning observed a spider busily engaged in weaving its delicate web. To make it firm and extensive, Arachne endeavoured to fasten her filmy threads on a beam projecting from the roof; but in attempting to reach it she fell to the ground.

Six times, and each time with no better success, she repeated the attempt; but instead of being discouraged, she made a *seventh* essay, reached the wished-for point, fastened her adhesive cord, and went on with her work triumphantly. On observing this singular instance of successful patience and victorious perseverance, the king sprung to his feet with hopes revived and resolution

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reinvigorated. "Shall I," said he, "be more easily discouraged than this reptile? Shall she, in spite of repeated failures, persevere till crowned with success, though her object is to enslave and destroy? And shall *I* leave anything unattempted that I may deliver my countrymen from subjection?" He hastened to the beach, launched a fishing-boat, sailed from King's-cross-point for Ayrshire, which he reached in safety; secretly assembled his soldiers and vassals in Carrick; made a bold, sudden, and successful attack on his own castle of Turnberry, which he captured from its English garrison; and, following up this auspicious stroke, he advanced in his career of victory until he effected the deliverance of his countrymen on the red field of Bannockburn.

And now, before I take leave of spiders, let me remark that in tropical countries some species attain so large a size as to be capable of preying upon small birds. In Borneo they are remarkable for their splen-

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did show: they are enclosed in a skin of a shell-like texture, and of colours of every hue—brilliant and metallic as the feathers of the humming-bird; but these colours depend on the life of the insect which they adorn, so that it is impossible to preserve them.

All spiders are now divided into five classes: Hunting spiders, Wandering spiders, Prowling spiders, Sedentary spiders, and Water spiders.

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CHAPTER II.

THE SILKWORM IN CHINA, AND ITS HISTORY.

MAN often prides himself on his independence, and assumes the proud title of Lord of Creation; yet is he dependent, in every circumstance and condition of life, upon outward objects. His "mind" may be to him, as the poet says, "a kingdom;" he may be master of his own will, and ruler over his own desires; he may exercise a certain degree of control over his swiftly-passing thoughts, and subdue to some extent his passions and his feelings; but in his relations to the external world he is verily a slave. He cannot feed himself without the help of the fowls of the air and the plants of the field; nor can

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he protect his body from summer heat and winter cold without having recourse to the fragile flax, or the fleecy down of the cotton-tree, or the wool that clothes the back of sheep and goat.

Looking at the question in this light, we see much that should humiliate our pride and teach us a spirit of lowliness; but, on the other hand, it may be admitted that there is also something in it to stimulate our sense of the strength and extent of our faculties. For is it not a proof of our intellect, that we have contrived to adapt to such uses things and substances apparently the most unpromising?—that from the coarse shaggy covering of the sheep we have succeeded in weaving so beautiful a material as cloth, and from the downy seeds of the little *gossypium* so valuable a stuff as cotton?

Of all that man has done, however, in the way of increasing his resources for clothing and personal decoration, I think the most sig-

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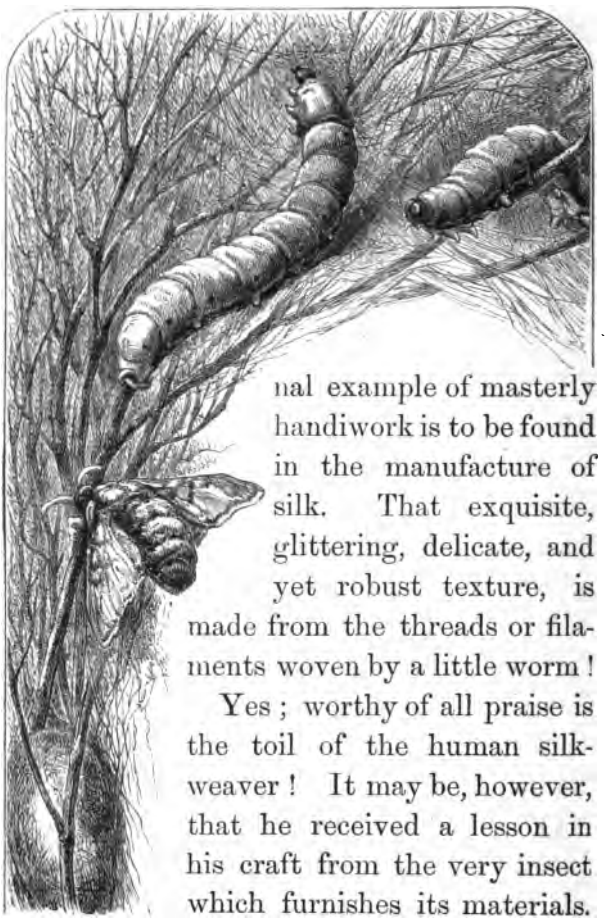

nal example of masterly handiwork is to be found in the manufacture of silk. That exquisite, glittering, delicate, and yet robust texture, is made from the threads or filaments woven by a little worm!

Yes; worthy of all praise is the toil of the human silk-weaver! It may be, however, that he received a lesson in his craft from the very insect which furnishes its materials.

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I have spoken of it as a worm; but here I do it an injustice. The so-called silkworm, in its first stage of life, is a moth—a whitish moth, with a broad pale-brown bar marking each of its upper wings. It belongs to a genus of moths called, in scientific language, *Bombyx;* and its own special and distinctive name is *Bombyx mori,* because of its partiality to the leaves of the *morus,* or mulberry-tree.

To what region or country the silkworm was indigenous—that is, where it originally made its appearance—I am unable to tell you. It has been domesticated by man from the earliest times, and, like all domesticated animals, has lost much of its natural strength. We are told that the silkworm-moth can no longer maintain its position in the air, or on the leaves of the mulberry when the "gentle breaths of heaven" disturb them. No longer does it know how to shelter itself beneath the cool green foliage from its various foes, or from the smiting arrows of the sun. The

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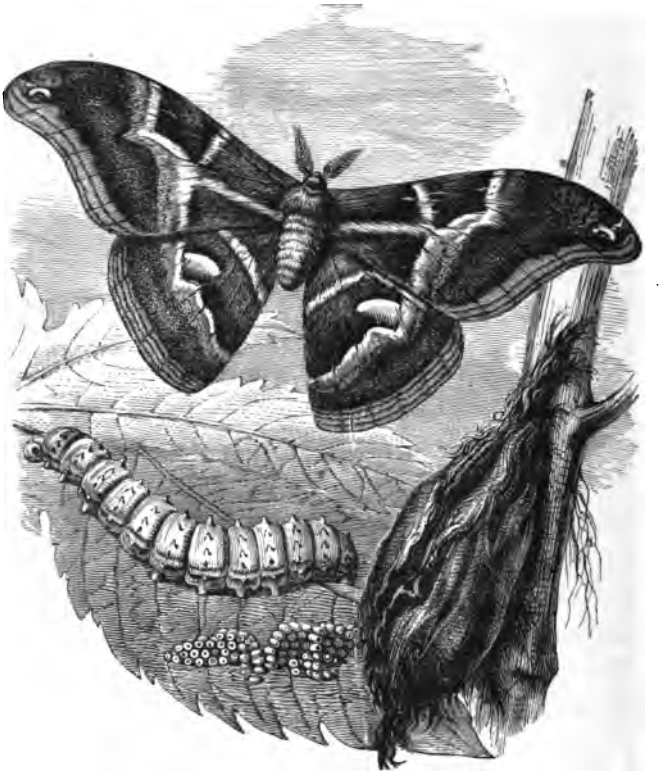

THE BOMBYX MORI OR MULBERRY SILKWORM:—ITS MOTH, CATERPILLAR, EGGS, AND COCOON.

female, always motionless, seems to have forgotten that she is endowed with wings.

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Her mate no longer enjoys aërial flights, but hovers about his companion, without ever rising from the ground. Such is the influence exercised upon animals by a state of domestication.

If we do not know the native country of the silkworm, we know, at all events, where its product was first turned to the advantage of man.

There lived in China, about two thousand six hundred years before the birth of Christ, an emperor, named Hoang-ti, who was very desirous that his wife, Si-ling-chi, should add to the happiness of his people by increasing their resources and extending their occupations. Up to this date the Chinese had employed the skins of animals for clothes. Si-ling-chi now bethought herself of turning to some such use the fine silken threads woven by the silkworms; and causing a great quantity of them to be collected, she began to study their habits. A woman's wit is seldom baffled, and in due time she not only

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discovered the means of rearing them, but also the manner of winding off their silk, and of employing it in the manufacture of a fabric suitable for clothing purposes.

Thenceforward the Chinese empresses, for many centuries, found a pleasant as well as useful occupation in superintending the hatching, rearing, and feeding of silkworms, in making silk, and working it up when made.

To the palace of Pekin was attached a garden planted with mulberry-trees. Here the empress, accompanied by her most illustrious ladies, paraded in all the pomp and splendour of imperial state on the festival-day of the great god Chang-si; gathering with her own hand the leaves of those branches which her attendants lowered within her reach, and offering up as a sacrifice the first pieces of silk woven by her own royal hands, or made by her orders, and under her immediate superintendence.

The silk manufacture, thus encouraged by

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imperial patronage, soon extended over the whole Chinese empire, and became a source of great wealth. To promote the rearing of these useful insects, one of the emperors gave twenty acres of land to every individual who planted fifty feet with mulberry-trees. The emperor Hien-tsang, who ascended the throne in 806, desired that two feet in every acre should be planted with these trees. The exportation of the silkworm's eggs was forbidden, under pain of death; and great care was taken to confine the art of silk-weaving within the borders of the empire. The manufactured article, therefore, became an object of desire to other nations; and on account of its rarity was all the more highly prized. In the days of Alexander the Great its value in Greece was exactly its own weight in gold;—a pound of silk for a pound of gold! To the Romans it was unknown until introduced, under very singular circumstances, by Julius Cæsar. It is said that on the occasion of a grand show of

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wild beasts and gladiators in the amphitheatre, instead of the coarse cloth awning previously employed to ward off the rays of the sun, he substituted a magnificent expanse of silken tissue. The new material immediately grew into favour with the luxurious Romans; and the young patricians vied with each other who should appear in cloaks of silk. From Rome the new material spread into other European countries, still maintaining its almost fabulous price, on account of the monopoly which the Chinese jealously preserved.

It happened, however, about the middle of the sixth century, that two monks of the order of St. Basil had penetrated, in the course of their missionary labours, into China. Here they obtained a knowledge of the processes of the silk manufacture, and resolved upon an attempt to introduce it into Europe. For this purpose it was indispensable they should carry off some silkworm's eggs;—a difficult, and, under the circum-

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stances, a dangerous task. That on leaving China their persons and baggage would be rigorously searched, they were well aware; and therefore they had to devise some means of effectually secreting their treasure. Having obtained a quantity of eggs, they concealed them, along with a supply of mulberry leaves, in the hollows of a couple of bamboos, which they employed as walking-sticks; and with these in their hands they crossed the mountains and the rivers of India, the plains of Persia and Syria, and made their way to Constantinople (A.D. 552).

The eggs which they brought became the parents of countless generations, which, extending over Greece, Italy, Spain, and France, have largely added to the industrial resources of Europe. Nowadays silk, in some one or other of its shapes, has come within the reach of the poorest. If silk dresses are still confined to the wealthy, the humble village maiden can deck her Sunday bonnet with a silk ribbon, and the parish

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school-boy twist a silken tie round his sunburnt neck. In fact, it has become an article of necessity as well as of luxury, and its manufacture gives employment to thousands of industrious workmen, whether at Lyons or at Coventry.

There is something very attractive in the appearance of silk; in its smoothness, softness, firmness, and brilliancy. But there is nothing attractive in the appearance of the insect which furnishes it. Yet in that insect's organization and condition of life, certain facts are well calculated to excite the attention of the thoughtful. "I was occupied the other day," says Mr. Jesse, "in reflecting on the benefits accruing to mankind from a remarkable instinct impressed by the Creator on that insignificant insect, the silkworm. What warmth and comfort does it afford to us! How useful, convenient, and elegant is the clothing we derive from it! But this is not all. Let us, for one moment, consider how many

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thousands of persons are indebted to it for almost their very existence, in consequence of the employment it affords to man in nearly every country of the known world. There is, however, another striking and interesting peculiarity attending the silk-

THE BOMBYX MORI IN ITS CATERPILLAR STATE.

worm. It is this: that while the caterpillars of all the other tribes of moths and butterflies, when they have arrived at a certain state of maturity, show a restless disposition, and wander about and hide themselves in a variety of places, in order to

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spin their cocoons, preparatory to their making their escape as moths, &c., the caterpillar of the silkworm, on the contrary, is content to remain stationary in the open tray or box in which it may be placed. After consuming its immediate supply of mulberry leaves, it waits for a further quantity; and when the period arrives for spinning its cocoon, instead of showing any migratory disposition, it seems to place itself with confidence under the care of man to provide it with a suitable place for its convenience and protection. In the fly or moth state, the female is quite incapable of flight; and the male, although of a much lighter make, and more active, can fly but very imperfectly. This latter circumstance insures to us the eggs for the following season; thus completing the adaptation of the insect in its different stages to the purposes it is destined to fulfil for our advantage.

"To my mind," adds Mr. Jesse, "this

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striking peculiarity in the habits of the silkworm illustrates the care and kindness of the Almighty, in thus making an apparently insignificant insect the means of so many important benefits to man."

And now for a description of the various stages in the life of a silkworm, which, in its time, "plays many parts.

The larva, or caterpillar, which we call the silkworm, is of a yellowish-gray colour, and, when full-grown, nearly three inches long. Its body is composed of thirteen segments, or joints, with, in front, three pairs of articulated or jointed legs, and in the middle and towards the posterior joints are five pairs of membranous legs, furnished with a ring of very fine hairs which enable the animal to fasten itself on to leaves and stalks.

The mouth of the silkworm is a peculiar feature. It consists of six small articulated pieces. In the middle of the upper lip is a hollow, into which the leaf fits that the

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THREE STAGES IN A SILKWORM'S LIFE.

animal is gnawing, so that no effort is required to hold it. Beneath this lip are

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inserted two larger jaws, which act like scissors in cutting up the leaf. The fragments are further divided by some weaker jaws, placed below the large jaws; and a little trunk, jointed to each of these, pushes the vegetable food back into the mouth, and prevents "the smallest particles" from being lost. Lastly, in the space between the two greater jaws exists a kind of protuberance, pierced with a hole, through which the worm ejects its silken thread.

Remember, too, in completing your idea of the animal, that it has nine breathing-holes (*stigmata*) on each side of its body, and seven eyes on each side of its head.

So much for the external appearance of the silkworm. I will now endeavour to describe to my young readers the internal organs which make and emit the silk.

Dissect a silkworm, and you will see a double apparatus, situated on either side of what is called the "intestinal canal," and below it. In scientific language this is

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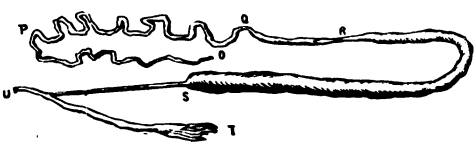
known as the "double sericipary gland." Each gland consists of a tube, divided into three distinct parts, of which that lying nearest to the tail of the worm forms a kind of bent tube (O, P, Q), about one-thirtieth of



SILK-MAKING APPARATUS OF THE SILKWORM.

an inch in diameter, about nine inches in length, and twisted into a number of irregular zigzags. This zigzag tube is enclosed in an enlarged vessel (R, S), the reservoir of the silk-producing matter; to whose extremity (S) is attached another minute hair-like tube (S, U), which terminates at U in one single short canal, opening in the orifice below the worm's under lip.

The silky matter collects in the reservoir (Q, R, S), and remains there in what is termed a *glutinous* condition; but on reaching the

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capillary tubes* it grows consistent, and forms two threads, which at the point of junction (u) unite together, and are projected through the orifice as one single filament, to be directed by the animal to any particular point or object.

The silkworm remains in a larva or caterpillar state for about six weeks, changing its skin (or "moulting") four times during that period, and abstaining from food for some time previous to each moult. When full-grown it altogether leaves off feeding, and begins to weave itself a loose coat of silken fibres in some convenient spot which it has selected for the purpose; afterwards proceeding to encase itself in a much more closely woven substance, until it resembles an oval ball of yellow silk about the size of a pigeon's egg, called the *cocoon*. In this it changes to a chrysalis, or grub; and after lying thus imprisoned for about fifteen

* Capillary—from the Latin *capillus*, a hair—hair-like, as fine and thin as a hair.

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days, gives birth to the moth. When the silkworm is reared for commercial purposes, this issue is carefully prevented, as the moth

COCOONS OF THE MULBERRY SILKWORM

greatly injures the silk of the ball by discharging a quantity of coloured fluid before it leaves the cell. The use of this liquid,

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however, is apparent: it moistens the cocoon, and separates the threads composing it, so that the moth may force a passage to the light of day.

When the female moth is about to lay her eggs, she looks out a secure and convenient place; and having found this secure and convenient place, she deposits there an egg covered with a gluey liquid, which causes it to stick to any object upon which it may chance to fall. Shortly afterwards she lays a second egg by the side of the first, a third by the side of the second, and so on. This process occupies about three days, and the number of eggs deposited varies between three hundred and seven hundred. They are shaped like a lens, and flattened towards the centre.

When first laid their colour is a bright yellow, which in a week changes to brown; and in due time the brown is succeeded by a reddish, and afterwards by a slatish-gray tint; it retains the latter shade through-

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out the autumn, the winter, and a great part of the spring. Then, as the warmer weather comes on, we find the colour of the eggs passing successively through bluish, violet, ashy, and yellowish hues. Finally, as the eventful moment of hatching approaches, they become very nearly white.

Take up an egg, when in this condition, and you will observe a tiny black spot at the extremity, and all along its circumference a brownish crescent. The black spot is the worm's head, which closely touches the shell; the brown crescent, the body, already covered with small fine hairs. On leaving the egg, the silkworm eats through the shell on the *side*, never on the flat surface; and when it has effected a sufficiently large opening, breaks through it, head foremost, and immediately attaches a silken thread to the nearest object, evidently to secure a resting-place. If the opening be too small for the head, the larva is compelled to emerge into the world with its tail foremost; and at

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other times, being unable to release its head, perishes of hunger and fatigue.

Silkworms are now bred—educated, as it were—with a commercial object. Large establishments undertake this singular kind of traffic; and in France especially, they are organized on a scale of great importance. It has also been attempted in England, but not with much success; and in the south of Ireland some French refugees made considerable plantations of mulberry-trees during the last century, but none of them are now in existence.

In undertaking to breed silkworms, the first and indispensable thing is to obtain good eggs, or, as they are technically called, *grain*. The premises in which the rearing is carried on must be thoroughly ventilated, and at the same time well defended from cold draughts and inclement winds. The air should be warmed before it reaches the rearing-chamber.

In this chamber are placed a number of

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racks; and in the racks, at a distance of about eighteen inches from each other, are arranged certain frames, or *canisses*, made of reeds, and averaging from three to five feet in breadth. To protect the worms from falling, a small border, two or three inches in height, surrounds each frame; and to insure cleanliness, the bottom is covered with large sheets of paper. A careful silkworm-rearer will also take care to provide a cellar, or cool room, where he may store his leaves immediately they are brought in from the country.

It is almost needless to say that silkworms are fed on the leaves of the white mulberry; or, when these cannot be obtained, on that of the black mulberry and the lettuce.

In very large establishments the rooms are arranged on mathematical principles, and warmed and ventilated in the most scientific manner. The front looks to the east, and the back to the west. On the ground-floor are placed the store-rooms, the

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A FRENCH SILKWORM NURSERY

air-chamber and heating-apparatus, and the chamber of incubation; the first floor, always very lofty, constitutes the rearing-room, properly so called.

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CHAPTER III.

THE GROWTH OF SILK.

LET us now trace the story of a silkworm, from its entrance upon the stage of life to the moment when its precious product is greedily collected by human hands.

According to Shakespeare, man has *seven* ages; the silkworm has only *five*.

Its *first* is the period of four or five days which elapses between its escape from the egg and its first change of skin, or "moulting." At this epoch it is fed from six to eight times daily—that is, between eight in the morning and twelve at night, the tenderest leaves being chosen, and cut into very small pieces.

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When the moult is approaching, the little worm is placed on a litter made of green boughs, and allowed to go to sleep. On awakening after its change of skin, it is removed to fresh leaves, and again fed with carefully-cut food, in a room whose temperature must not be less than 55°. It now receives four meals a day.

The *second* stage lasts four days, and the worm again moults. In the *third* period it still receives its four meals, but the leaves are now cut into much larger pieces. It moults for the third time on the thirteenth or fourteenth day after hatching; and for the *fourth*, on the twenty-second or twenty-third day. During its fourth age, the mulberry leaves are given to it whole.

The moult following its fourth age is described as the most critical period of its life. During its sleep it suffers keenly, and is plunged into a state of lethargy resembling death, which lasts from thirty-six to forty-five hours.

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The caterpillar has now attained its maximum of size and appetite. It begins to elaborate the silky matter in its reservoirs, but after a while discontinues feeding, and soon diminishes in both size and weight. This usually occupies a period of nine or ten days, after which it commences to spin its silken thread.

As it requires to remain uninterrupted during this process, we usually give it, says a French writer, some little stalks of heath or broom, or a piece of rolled-up paper, into which it retires, and where it may be seen moving its head to different places in order to fasten its thread on every side. All this work, though it looks to a bystander like "confusion worse confounded," is not without design. The caterpillar neither arranges its threads, nor disposes one over another, but contents itself with distending a kind of cotton or floss to protect it from the rain. God having ordained the silkworm to work under sheltering leaves, it never

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changes its method even when artificially reared.

When I was led by my curiosity, says our authority, to know how it spun and placed its exquisite silk, I frequently removed the floss with which it first attempted to cover itself. As by this means I weakened it greatly, it became weary of beginning its work afresh, and, fastening its threads on the first object it met with, began

THREAD OF SILK, SEEN THROUGH A MICROSCOPE.

to spin in my presence with the utmost regularity, bending its head to and fro, and up and down. Soon, however, it confined its movements to a limited space, until by degrees it had completely encased itself in silk, and the remainder of its operations became invisible: what they are, however, may easily be inferred if you examine the work when completed. In order to perfect the structure, it must draw out of the gum-

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bag a more delicate silk, and then, with a stronger gum or varnish, knit all the inner threads one over another.

There, then, we see before us three distinct coverings, each affording a successive shelter. The outer loose silk or floss is to protect the animal from rain; the fine silk in the middle prevents the wind from inflicting any injury; and the glutinous silk—the tapestry or hangings of the snug chamber wherein the little weaver lodges—repels both air and water, and effectually screens it from cold.

After weaving its cocoon, the caterpillar is transformed into a chrysalis, and subsequently into a moth (the *Bombyx mori*); when, without saw or knife, it cuts its way through the shell, the silk, and the floss; for the Being who teaches it how to construct its place of repose, where the coarse worm may develop peacefully into the delicate moth, instructs it likewise in what manner to open up a passage for escape.

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Beautiful symbol of the Soul, which thus emerges from its rude corporeal case, to wing its way into a brighter and purer life, until the time comes for it to assume, at its Creator's bidding, a glorified and perfect body!

It is the middle portion of the cocoon, after the outer floss or loose silk is removed, which we make use of in our manufactures. The first step in the process is to throw the cocoons into warm water, and stir them about with twigs, until any slight gummy excrescences which may have been produced while the caterpillar was spinning are dissolved. The threads of a certain number of worms, according to the strength of the silk required, are then taken and wound off upon a reel. The refuse, consisting of what we may call "the tops and bottoms of the cones," are not *wound*, but *carded* or combed, like wool or cotton, for the purpose of forming coarser fabrics. From the fact that the cocoons are generally unwound without the

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thread breaking, we may infer that the little weaver completes its woof without interruption. It is a popular but very erroneous belief, that if it be disturbed in its work by any noise it will take fright, and break its thread.

The length of the unbroken thread in a cocoon varies from six hundred to a thousand feet; and as it is all spun double by the insect, it will amount in the whole to nearly *two thousand feet* of silk, and yet will not weigh more than three grains and a half! The usual average does not exceed four and a half pounds of silk to two thousand cocoons. When we consider, therefore, as a naturalist remarks, the enormous quantity of silk now in use in the world, the number of insects required to produce it will almost exceed our comprehension. The material employed in a lady's silk dress represents the produce of the labours of eight thousand insects!

There are two kinds of cocoons, white and yellow, proceeding from different races of silkworms.

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There are also two kinds of white silk, the *first white* and the *second white*. The former is produced by the race called *Sina*, whose cocoons are of a delicate azure-shot white, and are used only in the fabrication of light and exquisite tissues. The latter is furnished by two races,—the *Espagnolet* and the *Roquemauro*.

The races producing yellow cocoons are more numerous than their white congeners, and are divided into three groups: those that have small, middle-sized, or large cocoons.

Of late years various species of the bombyx moth have been introduced into Europe, with the view of acting as auxiliaries to the mulberry bombyces, and taking their place when any failure in the supply of the latter occurs through epidemical disease. Thus, there are three species of the genus *Attacus* which feed upon oak leaves: the *Yama-Maï*, the *Pernyi*, and the *Mylitta*.

The silk of the Yama-Maï is only inferior

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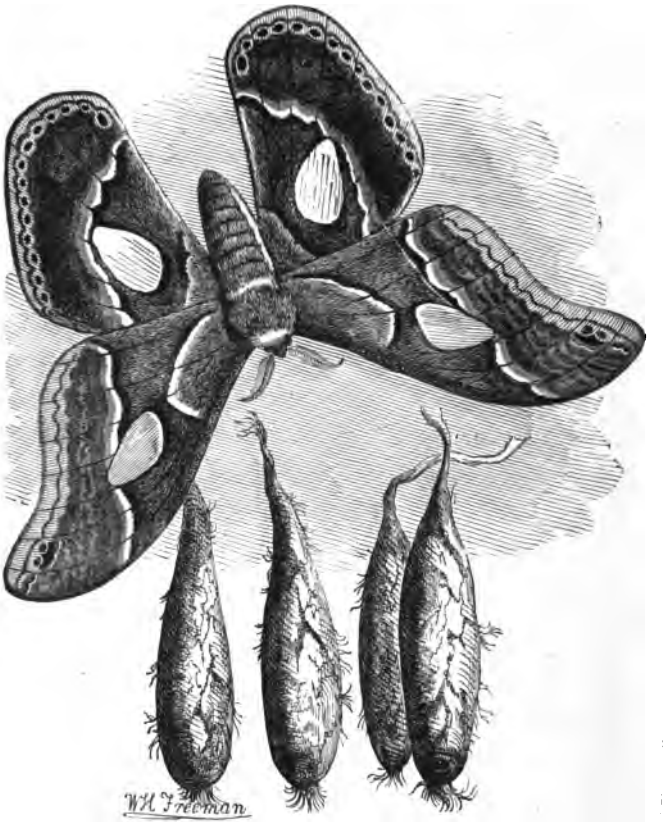

ATTACUS (BOMBYX) YAMA-MAI, AND COCOONS.

in quality to that of the mulberry silk-worm.

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The *Attacus Yama-Maï* was introduced from Japan in 1862, and its cocoon resembles that of the Bombyx mori. It is composed of a beautiful silk, green externally, and in the interior of a silvery whiteness. Our illustration represents the cocoons and the moth, which is large and radiant, and of a bright yellow colour.

The silk of the *Mylitta* is also of an admirable quality. It is found in various parts of Hindustan, especially in Bengal, and at Lahore and Calcutta, whence its tissue is exported under the name of *tussch*. Brown stuffs, firm and bright, adapted for summer clothing, are woven from it by the Hindus.

The largest European moth is the *Saturnia*, of which one species, the *Saturnia Pavonia-major*, is never found further north than the latitude of Paris. Its wings are brown, undulated, and finely checkered with gray. Upon each is a large crescent-shaped spot, surrounded by a tawny ring, and surmounted by one white semicircle, and another

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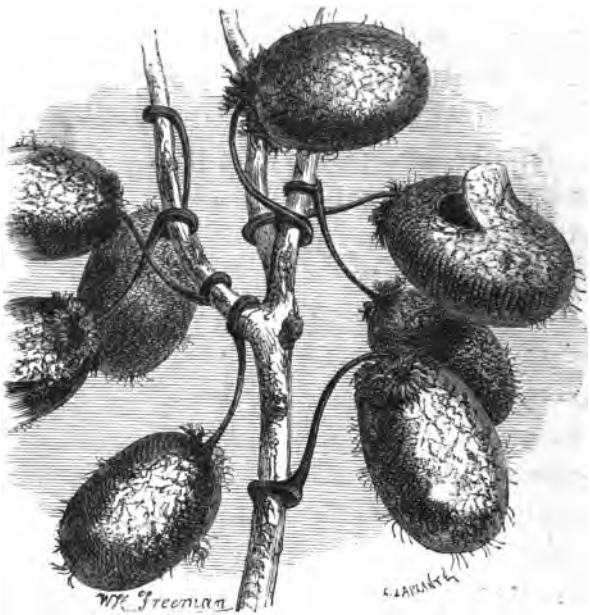
of a reddish hue—the whole completely enclosed in a black circle. It spins a brown



COCOONS OF THE ATTACUS (BOMBYX) MYLITTA.

cocoon, consisting of a very strong coarse silk.

The other species of Saturnia is well known in England under the name of the Emperor

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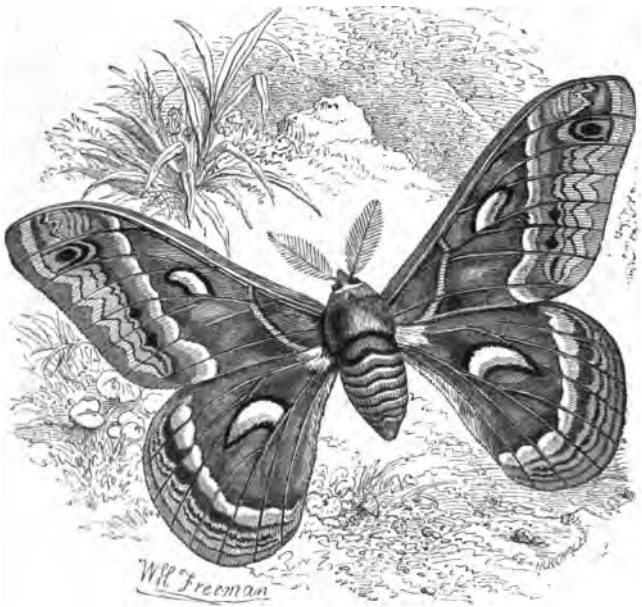
Moth (*Saturnia Carpini*), and is not less remarkable for the brilliancy of its colours



EMPEROR MOTH (*Saturnia Carpini*).

than for the skill it displays as a weaver. Its caterpillar feeds upon fruit-trees and on the willow, spinning a cocoon, shaped like a Florence flask, of strong silk; a silk so

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thickly woven that it appears almost like damask or leather.

Here, then, we close our little narrative, woven together of so slight a texture, and yet sufficient in itself, we hope, to fill the minds of our young readers with wholesome thoughts, and to impress them with a fresh sense of the wondrous wisdom and infinite resources of Him in whom the spider and the silkworm have their being, no less than the lion of the forests or the leviathan of the deep; guided by His laws, fulfilling his decrees, and adapted by His all-seeing providence to the due performance of their parts in the grand economy of the universe.

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